***Original Research Article***

# Understanding the Cause and Effect of Bent Side Rail at Molding Process


## ABSTRACT

During processing of QFN on the production line, it has been observed that strips were found with bent rails after molding process. Mold is a process in a semiconductor industry where package encapsulation happens by filling the cavities with molding compound, depending on the required package thickness. Succeeding processes of post mold cure and laser marking was not affected by the encountered bent rails at mold but singulation process feedback that the affected strips prompted jig alignment errors. The study focuses on understanding how bent side rails can be induced aiming to minimize its occurrence and preventing to cause errors at the downstream processes specially at singulation.



*Keywords: Jig Alignment Error, Mold Process, Bent Side Rail, QFN, Transfer Mold*


## 1. INTRODUCTION

Transfer molding is a process where the units build with die and wires are being unified thru encapsulation. After the strips were molded, it will undergo other downstream process such as post mold curing and laser marking before it reaches the singulation process where the strips will be cut into single units.

For the strips to proceed with singulation, alignment should satisfy the limit settings at the machine. If the alignment settings were not met, machine will prompt errors for assistance. One of the errors that was frequently encountered was the jig alignment error. Strips that have been encountered with jig alignment errors were inspected and found out to have a bent side rail. Other strips without bent rails were successfully processed at singulation without any errors.

Occurrence of bent side rails were traced back to be induced after mold process. Strips that were loaded on the molding machine has been validated to have flat side rails but upon unloading, bent rails were evident.

Data on hand have pushed the authors to come up with a technical study on how these bent rails were induced and how it can affect the singulation process. The authors aim to come up with the recommendations that would address the occurrences of bent rail.

## 2. METHODOLOGY

The authors have taken to study the mold process and validate how the process can produce strips with bent rails. Although bent side rail will not reject products, it has been observed that it will take longer time and assistance for the strips to be processed at


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singulation. The authors have also studied why the bent side rails affects the downstream process of singulation. Once data were collected, the next activity is to analyze how to address the occurrence of bent rail. Lastly, the authors conclude and recommend the alternatives that can be considered with the encountered issues considering the results and validations that was brought about by the methodology.

### 2.1. Studying the Mold Process

Mold Process is where to perform package encapsulation by filling the cavities with molding compound. The process starts on a loading module where the strip magazines are loaded to a platform, followed by input indexing or strip pick-and-place module to transfer strips from the magazine to preheater. Pre-heat module was then used to heat up strip in preparation for higher temperature of molding. Shown on Figure 1 is the pre-mold transfer module that transfer of strips and molding compound pellets into molding module. Molding module shown on Figure 2 is where package encapsulation occurs by filling the cavities with molding compound. After molding, strips will be picked and place on de-culling module show on Figure 3 where mold culls were removed from molded strips. Culls were the cured mold compound remains after transfer molding. Strips will be unloaded after de-culling processes.

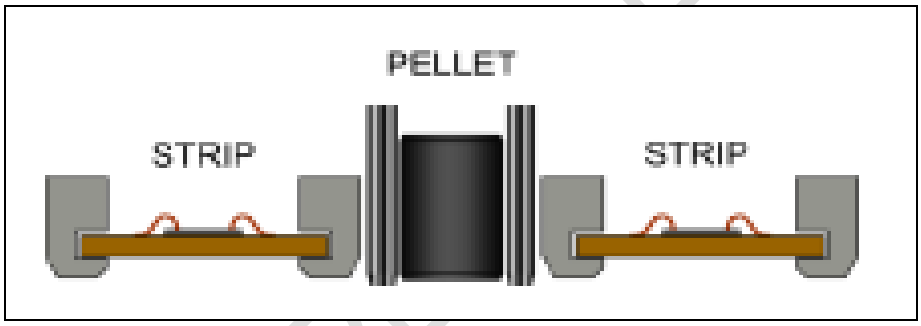


**Fig. 1. Pre-mold transfer module**

**Fig. 2. Molding Module**

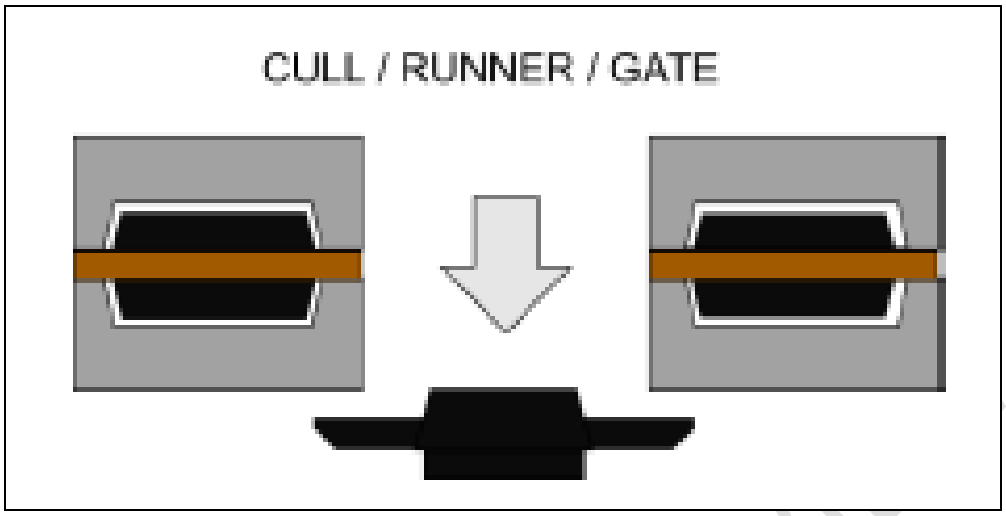


**Fig. 4. De-culling Module**

Molding process was done to ensure that the components inside the units were secured and protected. Mold compound pellets were melted before transferring and occupying the mold chase. Several process steps were done before the strips reaches singulation and bent rails were not an issue until singulation process.

### 2.2. Analyzing How Bent Side Rail Occurs

The authors have validated if the bent rail signature can be found prior strip molding but the strips were not damaged or bent before loading the strips at mold. However, inspection of the strips upon unloading was observed to have bent rails. The authors have focused to find where can bent rail be induced inside of the molding machine and it was found out to be on the unloader de-culling area.

When the strips are done molding, the molded lead frames will be picked up by the unloader picker and then will be placed at the de-culling module to separate the strips and removes mold culls. Upon observation, it has been found out that the position of the molded strips was misplaced with de-culling module upon transfer from mold chase, thus made the molded strips placed beyond the position of strip stopper guide of the de-culling module. Strip stopper guide hits with the strip side rail upon strip placement resulting to side rail bend. Shown on Figure 4 is the actual validated sample of strips that has resulted with bended side rail.

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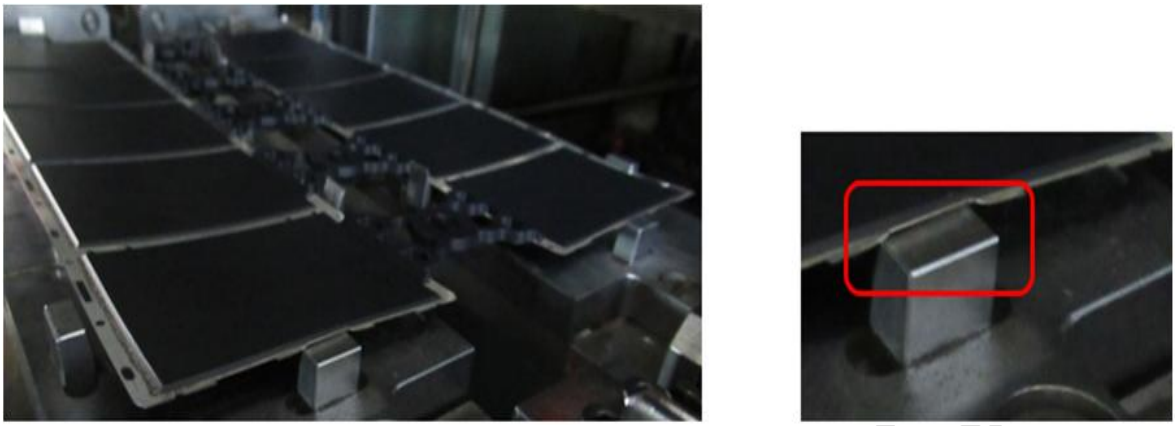

**Fig. 4. Molded strips at de-culling module**

Strip misplacement happens when the motor pulse rate parameter which is responsible for the unloader position of the strips from mold chase and de-gating module was not aligned to the proper unloading strip placement. Thru optimization of motor pulse rate parameter, unloader position with respect to the de-culling module was corrected and resulted with eliminated occurrence of strip bent rails.

## 3. RESULTS AND DISCUSSIONS

With the data collected thru the methodology of the study, it has been found out that bent side rail of the strip was caused by misalignment of the strip with the de-culling module upon loading placement. Optimization of the motor pulse parameter have solved the problem by elimination of bent rail occurrence.

Strip with bent rail have been processed thru post mold cure and laser marking without error noted. However, jig alignment error was encountered at Singulation.

### 3.1 Jig Alignment Error at Singulation Process

Singulation process was equipped with jig alignment validation to ensure that the strips were aligned with the chuck table rubber nest jig before it proceeds with strip cutting. Jig alignment errors occur when the machine measured that the strip alignment and strip placement with the rubber nest jig was high enough to be compensated. During validation, strips with bent side rail prompts jig alignment errors.

Strips that were affected with bent side rail at mold causes jig alignment errors as the protruded area of the strip induces movement upon loading of the strip, thus cause failure at jig alignment measurement of the machine. The strip can still be processed by using of manual jig aligner to ensure that the protrusion of the strip will not induce strip movements upon loading. Yet, manual process takes time and manpower assistance unlike the normal automatic singulation process.

## 4. CONCLUSION AND RECOMMENDATIONS

Thru the results gathered in this study, the authors would like to conclude that bent side rail in Mold process was caused by misalignment of the position of molded strip upon unloading

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to the de-culling module. Adjustment on the motor pulse parameter can eliminate the occurrence of bent side rails.

The authors would also conclude that bent rails induce jig alignment errors at singulation due to the strip movements caused by bent protrusion. Strips encountered with jig alignment error caused by bent rail can be assisted thru manual loading of the strip using the aligner jig.

The authors would like to recommend that the strips affected by bent and defective side rail should be checked at Mold process to its placement position at carrier. This activity would help on avoiding the error of Jig Alignment error at Singulation process.

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